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The Safe, Fuel-Efficient Car

A Report on its Producibility and Marketing

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THE SAFE, FUEL-EFFICIENT CAR

A REPORT ON ITS PRODUCIBILITY AND MARKETING

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

U. S. DEPARTMENT OF TRANSPORTATION

WASHINGTON, D.C.

OCTOBER 1980

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THE SAFE, FUEL-EFFICIENT CAR
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1.1 INTRODUCTION

As Americans turn toward smaller, more fuel efficient cars, we can expect to see a steady rise in the number of deaths and injuries on our highways. Although the accent from now on will be on miles-per-gallon, the manufacturers -- without the installation of available safety improvements -- run the risk of trading safety for fuel efficiency, a tradeoff consumers should not and do not have to accept.

In looking to the future of the auto industry, the focus on safety takes on an increasingly important air, for competitive as well as humane reasons.

Both the Federal government and the automotive industry know that there need not be a contradiction between safety and fuel efficiency. The Department of Transportation (DOT) already has produced and tested experimental safety vehicles that deliver good gas mileage and protect occupants in crashes up to 50 miles-per-hour. By contrast, most production small cars fail to provide occupant protection in crash tests conducted at 35 mph. (1)

This study examines how the automobile industry might produce and sell an automobile similar to those vehicles developed under the Research Safety Vehicle (RSV) program administered by DOT's National Highway Traffic Safety Administration (NHTSA). The first company to produce such a car could strengthen its position in the market and gain a competitive advantage by exploiting an unsatisfied need for a safe, fuel-efficient car, particularly in an arena where little competition currently exists.

The technology is available now to build a more socially-responsible automobile. The major purpose of the government's experimental safety vehicle program has been to demonstrate to the public, as well as to the industry, what can be done to produce an attractive, affordable automobile that integrates fuel economy, safety, low emissions and the comfort features people want in a small car.

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*Numbers in parentheses denote references.

There is little doubt of the need for such a car. The vulnerability of small car occupants is vividly illustrated by statistics that show in the last three years -- in large car/small-car crashes -- 85 percent of the fatalities were occupants of the small cars. And as these smaller and lighter cars mix with the older heavier cars already on the road, it is inevitable that more collisions between large and small cars will result.

The American public supports improved motor vehicle safety as well as improved fuel efficiency, and there is no reason the two cannot be compatible. While consumers have fuel efficiency foremost on their minds when they shop for cars, safety is also a concern, and they recognize that they may be trading safety for fuel economy when they choose to buy a smaller car.

Experimental cars similar to those built for the government can be mass produced using today's technology, and the cost for retooling to produce a new concept experimental car is about the same as launching any new model. The vehicles could be produced within 3 to 3 1/2 years, provided adequate priority is given to the project.

Preliminary estimates indicate a large potential market for such a car, possibly in the range of 250,000 to one million units per year, although additional research is needed to quantify the extent of the demand and how to best market such a vehicle.

The study is organized in the following sections:

- Social benefits of RSV's
- Consumer features of RSV's
- Consumer demand for safe automobiles
- Production cost and lead time
- Summary and conclusions

1.2 SOCIAL BENEFITS of RSV's

The RSV's demonstrate conclusively that high levels of safety can be provided in small, fuel-efficient cars and that such cars can be produced today to meet the presently unfulfilled consumer demand. In addition, the RSV's are designed to satisfy what most consumers also appreciate in a car -- styling and comfort at an affordable price. If vehicles of this type were available to the public, fuel consumption would be decreased, and the toll in deaths and injuries would be drastically reduced.

Each year, over 50,000 Americans die in motor vehicle accidents and millions are injured. At present rates, 1 out of every 60 people born in the United States today will die in a traffic accident, and most of them will die young. Motor vehicle accidents are the largest single killer of Americans under the age of 44. For ages 5-24, automobile crashes account for 1 death out of 3. (2)

Motor vehicle injuries also cause staggering losses. Out of every three infants born today in the U.S., two will suffer injuries in a crash sometime during their lifetime. Motor vehicle crashes are the leading cause of paraplegia and quadriplegia, and a major cause of epilepsy. (3) Each year they cost society $50 billion in medical and rehabilitation costs, lost wages, welfare, and property damage. (2)

The sheer number of passenger vehicles involved in crashes each year is enormous - 18,000,000, or approximately 1 out of every 8 vehicles on the road. There is no magic solution in the future which will greatly reduce the number of accidents. And, unless the safety of small cars is improved, the number of fatalities and the severity of injuries will increase by as much as 15,000 deaths annually by the end of this decade. (4)

As the new smaller and lighter cars join the older heavier cars already on the roads, more collisions between large and small vehicles will occur. Of the passenger car occupants killed in two-car collisions, deaths in subcompact cars accounted for 25 percent of the total in 1977, rose to 27 percent in 1978, and climbed to 30 percent in 1979. (5)

An examination of crash statistics where subcompacts collided with full-size cars found that the occupants of the subcompact car were eight times more likely to be killed than the occupants of the full-size car. (5) A comparison of fatalities in two vehicle accidents among vehicles of different sizes is shown in Table 1.2-1. These data clearly show that occupants of smaller vehicles are at much greater risk than occupants of the larger vehicles in a large car/small car collision.

Table 1.2-1 A Comparison of Fatalities in Two-Vehicle Accidents Among Vehicles of Different Sizes

	LARGER VEHICLE SIZE				
	Compact	Mid-Size	Full	Light Truck	Large Truck*
Subcompact	3.4	6.3	8.2	8.4	51.5
Compact		1.9	2.3	3.2	25.0
Mid-size			1.3	1.7	28.8
Full				1.5	25.9
Light Truck					20.3

This chart illustrates the relative probabilities of fatal injuries to occupants when vehicles of different sizes are involved in accidents. For example, in a collision of a subcompact and a full size car the occupants of the smaller car are 8.2 times more likely to be killed than are the occupants of the full size auto.

*Large truck is defined as two unit combination truck.

Source: 1979 Traffic Fatalities - Preliminary Assessments (5)

Occupants of the smaller cars generally are at greater risk because:

- In collisions between vehicles of different weight, the forces imposed on occupants of lighter cars are likely to be proportionately greater than the forces felt by occupants of heavier vehicles;
- The occupant's survival space is generally less in small cars (Survival space, in simple terms, means enough room for the occupant to be held in the vehicle's restraint system without being smashed into injurious surfaces and enough room to prevent being crushed or hit by a collapsing surface); and
- Smaller and lighter vehicles generally have less physical structure available to absorb and manage crash energy and forces.

The market does not currently provide the American consumer with a wide choice of an affordable car which is fuel-efficient and safe. Consequently, the manufacturers are putting the consumer in the position of having to sacrifice safety to gain fuel economy.

A major purpose of the Department of Transportation's RSV program is to demonstrate technology which will prevent a sacrifice of lives to save fuel as consumers move to smaller cars. Although existing safety standards have saved more than 64,000 lives, they do not adequately compensate for the inherent dangers to the safety of the small car occupant in a large car/small car collision. (2) Safety standards to mitigate the large car/small car problem are included in NHTSA's Five-Year Rulemaking Plan which will influence the safety of small cars in the mid and late 1980's. The effectiveness of crash protection afforded small car occupants will also be improved in the early 1980's by a Federal Motor Vehicle Safety Standard which will require automatic restraint systems for all small as well as large cars.

Minicars Inc., under contract to the Department of Transportation, designed a lightweight safe car with 32 mpg fuel economy (EPA combined cycle). The Minicars RSV offers automatic occupant protection in frontal barrier crashes up to 50 mph, and side protection in car-to-car crashes with a full size car at closing speeds of 50 mph. (6)

The Calspan Corporation, under a second contract with the Department of Transportation, modified a contemporary European car (1976 Simca) to improve its safety, damageability and emissions. Chrysler was a major subcontractor in this program. The Calspan/Chrysler research safety vehicles

demonstrated automatic occupant protection in frontal car-to-car crashes at closing speeds up to 80 mph* in the front, 50 mph in the side and 45 mph in the rear. (6)

The level of safety demonstrated by these experimental vehicles is significantly greater than that available in any car on the market today.

Although neither experimental safety vehicle is presently in production, the designs, test results and technology developed for the prototype vehicles are available today -- to all manufacturers.

The production of the RSV would benefit society as well as the manufacturer. It would provide a unique product with high safety levels in the competitive fuel-efficient car market by attracting many former large car buyers who looked to their heavier cars for safety. If all cars on the highways contained the safety of the RSV, annual deaths would be reduced by more than 12,000. The fuel economy of the RSV exceeds the 1985 fuel economy standard of 27.5 mpg and is about double the fuel economy of the average vehicle-in-use today. (6)

*Approximately equivalent to a crash with a barrier at 40 mph.

1.3 CONSUMER FEATURES OF RSV's

1.3.1 HISTORY OF SAFETY VEHICLE DEVELOPMENT

Over 20 different experimental safety vehicles have been built and tested as part of an international cooperative program among the major automobile producing nations in the world.

The most fuel efficient of these vehicles is the Integrated Research Vehicle Volkswagen II (IRVW II) constructed by Volkswagen in cooperation with NHTSA. This vehicle was similar in size and weight to the Rabbit. It achieved 40 mph frontal barrier protection, 30 mph closing velocity car-to-car side protection, and 60 mpg fuel economy on the EPA combined cycle. The vehicle has many similarities to the Rabbit, and it could form the basis for a significantly improved Rabbit.

The safest of the fuel efficient experimental safety vehicles is the RSV constructed by Minicars under NHTSA contract. The design and development work for this vehicle has been completed under Government sponsorship and is available for use by any manufacturer. The use of this design would save a manufacturer development time and costs, although some final engineering work would be required for production.

Other experimental safety vehicle designs developed under NHTSA sponsorship are also available to manufacturers. These include the Minicars Large Research Safety Vehicle, (a modified Chevrolet Impala which meets the 1985 safety and fuel economy standards) and a five-passenger safety vehicle developed by Calspan which is a modified Chrysler Simca. Both of these vehicles demonstrate a lower level of performance than exhibited in the Minicars RSV, but significantly improved capability over existing production vehicles.

The principal focus of this report is on the production of the advanced technology RSV developed by Minicars. However, some analysis of the vehicle developed by Calspan with Chrysler will also be included. To avoid confusion, this second vehicle will be referred to as the Calspan Modified Safety Vehicle (MSV).

1.3.2 MINICARS RSV

The Minicars RSV is shown in Figure 1.3-1. This vehicle incorporates innovative design and styling and has exceptional safety features. It is a two-door, four-passenger sedan with an interior occupant space as large as most mid-size cars. Acceleration is 0 to 60 mph in about 20 seconds. Fuel economy

is projected at 32 mpg on the EPA combined cycle at 1981-1985* emission levels, when powered by a recent model Honda four cylinder spark ignition engine. Final confirmatory testing of this RSV to confirm earlier results on safety, fuel economy and emissions will be completed during 1980. (7)

The Minicars RSV offers significant advances in safety and damageability. Many of these features are shown in Figure 1.3-2.

The frontal and side structures are made of lightweight sheet metal sections filled with polyurethene foam which adds strength and stability to the steel. This structure provides a high level of occupant protection at a weight consistent with that found in the conventional structures currently used in cars that offer much less protection. The soft, resilient foam front end of the vehicle is designed to reduce pedestrian injuries. The driver and front-seat passenger are protected by an advanced air bag system, which has been tested at barrier crash speeds up to 50 mph. This protection is approximately equivalent to a collision with a car of equal weight at a closing speed of 100 mph. Side protection for front-seat occupants in car-to-car crashes at closing speeds of 50 mph has been demonstrated. The rear seat passengers are protected by advanced (force limited) safety belt systems in barrier crashes up to 40 mph. (6)

In the area of accident avoidance, a second-generation anti-lock brake system developed by Bendix is an extra cost option. An additional option is a small lightweight radar system developed by RCA which will monitor the road ahead for impending hazards. In the event of an unavoidable collision at speeds over 30 mph, automatic braking will reduce the impact speed to reduce the severity of the crash. (7)

*1981-1985 emission levels are .41, 3.4, and 1.0 grams per mile for hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x) respectively.

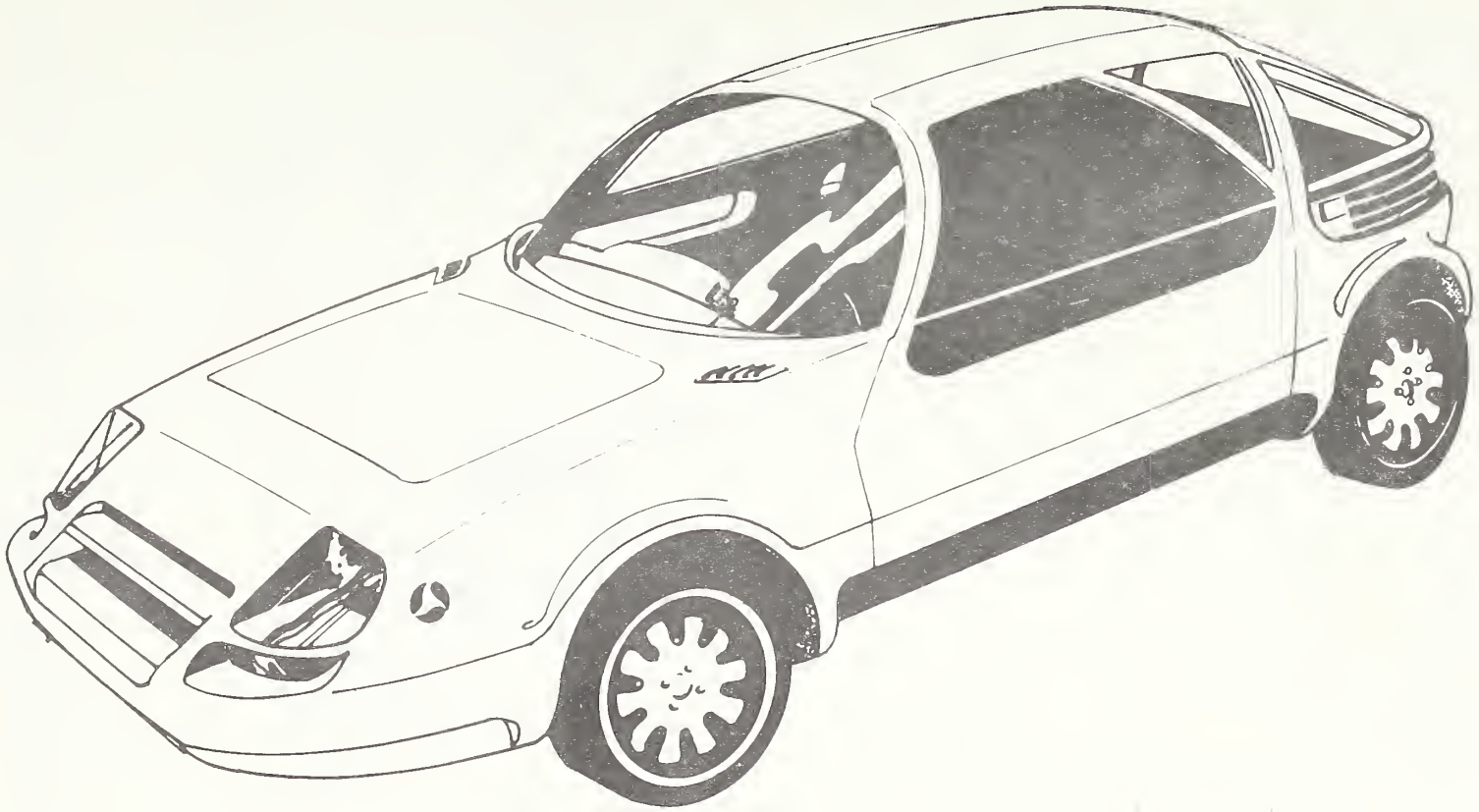

Figure 1.3-1 Minicars RSV

Features of Minicars
Research Safety Vehicle

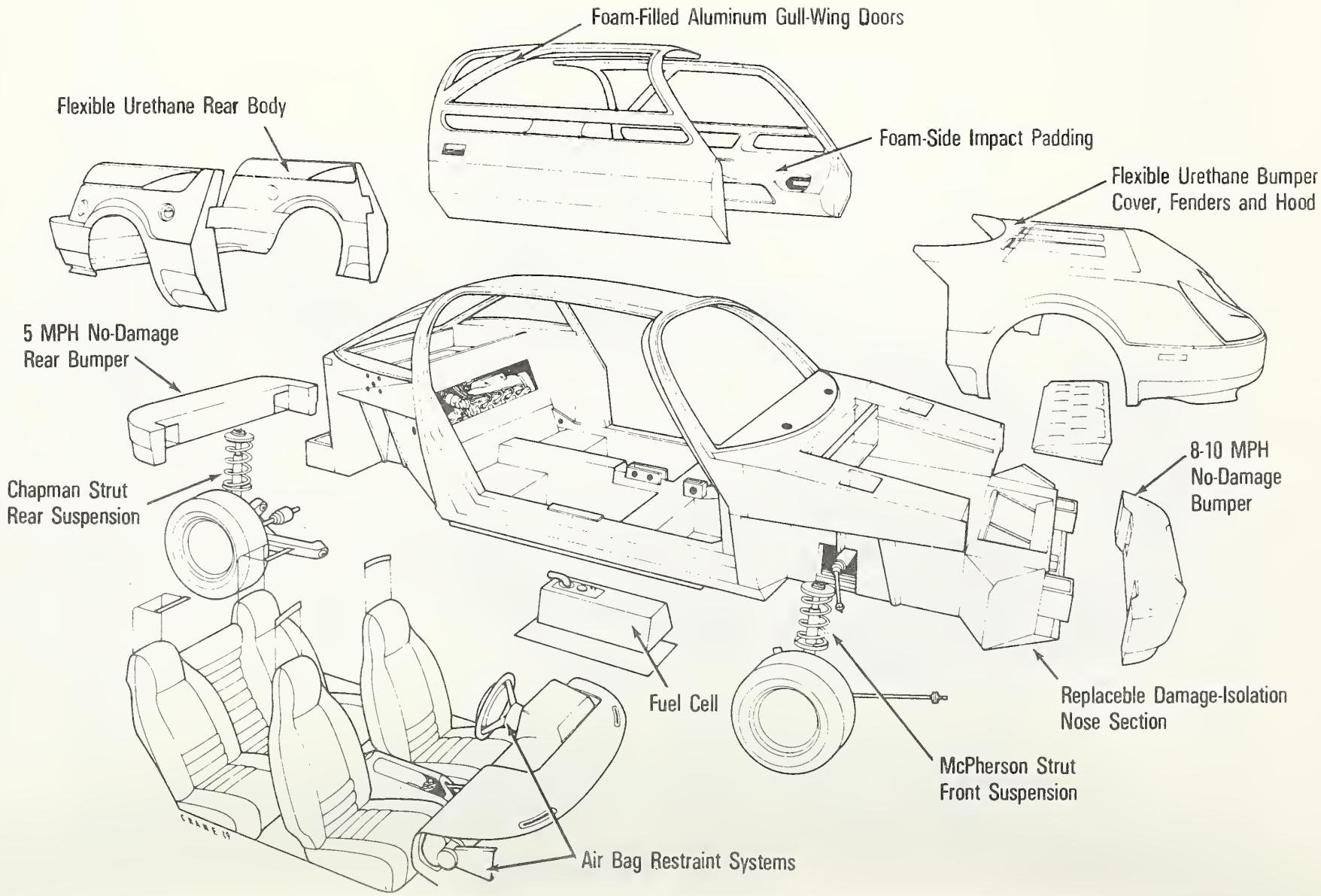
Foam-Filled Aluminum Gull-Wing Doors
Flexible Urethane Rear Body
Foam-Side Impact Padding
Flexible Urethane Bumper Cover, Fenders and Hood
5 MPH No-Damage Rear Bumper
Chapman Strut Rear Suspension
8-10 MPH No-Damage Bumper
Fuel Cell
Replaceble Damage-Isolation Nose Section
McPherson Strut Front Suspension
Air Bag Restraint Systems

Figure 1.3-2 Features of Minicars RSV

The RSV can be equipped with a number of optional engines and drivetrains. An alternative turbocharged diesel engine based upon the stock Volkswagen Rabbit engine* is being installed in the RSV. With this engine it is estimated that the RSV will achieve a fuel economy of 50 mpg with good acceleration.

The Minicars RSV has created a great deal of excitement all over the country and many people who have seen it on display want to know when and where they can buy it.

1.3.3 CALSPAN MSV

The design and styling of the Calspan vehicle utilizes a conservative, evolutionary approach based upon the modification of an existing European vehicle, the Simca 1308. The Simca 1308 was introduced by Chrysler France in 1975. It received strong consumer acceptance in Europe and was named the Car of the Year there in 1976. The General Motors X-Body cars, such as the Chevrolet Citation introduced in 1979, and the smaller Omni/Horizon vehicles introduced by Chrysler in 1978, have many of the characteristics of the Chrysler Simca 1308. Vehicles of this general design are highly fuel efficient and popular with consumers. There is reason to believe that the added and vital dimension of safety offered by the Calspan MSV would enhance the attractiveness of this type of vehicle.

The Calspan MSV, shown in Figure 1.3-3, is a four-door, five passenger sedan that incorporates front-wheel drive and employs a front, transverse engine. The base engine is found in the 1978 Dodge Omni/Plymouth Horizon, which meets 1978-79 California emission control levels. Fuel economy of the MSV on the combined EPA urban/highway cycle is 27.5 mpg. Acceleration performance is 0 to 60 in 17 seconds. The MSV with an optional turbochared, gasoline engine achieves 32 mpg fuel economy and 0 to 60 in 12 seconds (8). Yet, another engine alternative has been demonstrated. This alternative is a turbocharged diesel developed by Volkswagen and tested by NHTSA and EPA. This engine achieved 43 mpg in a vehicle of the same test weight as the Calspan MSV. (9) The engine uses the same block as the Calspan MSV engine and its application to the MSV as an option is technically feasible. Both optional engines meet 1981-1985 Federal emission levels. (6)

*The Omni/Horizon engine could be adapted to the RSV, also.

Calspan/Chrysler MSV

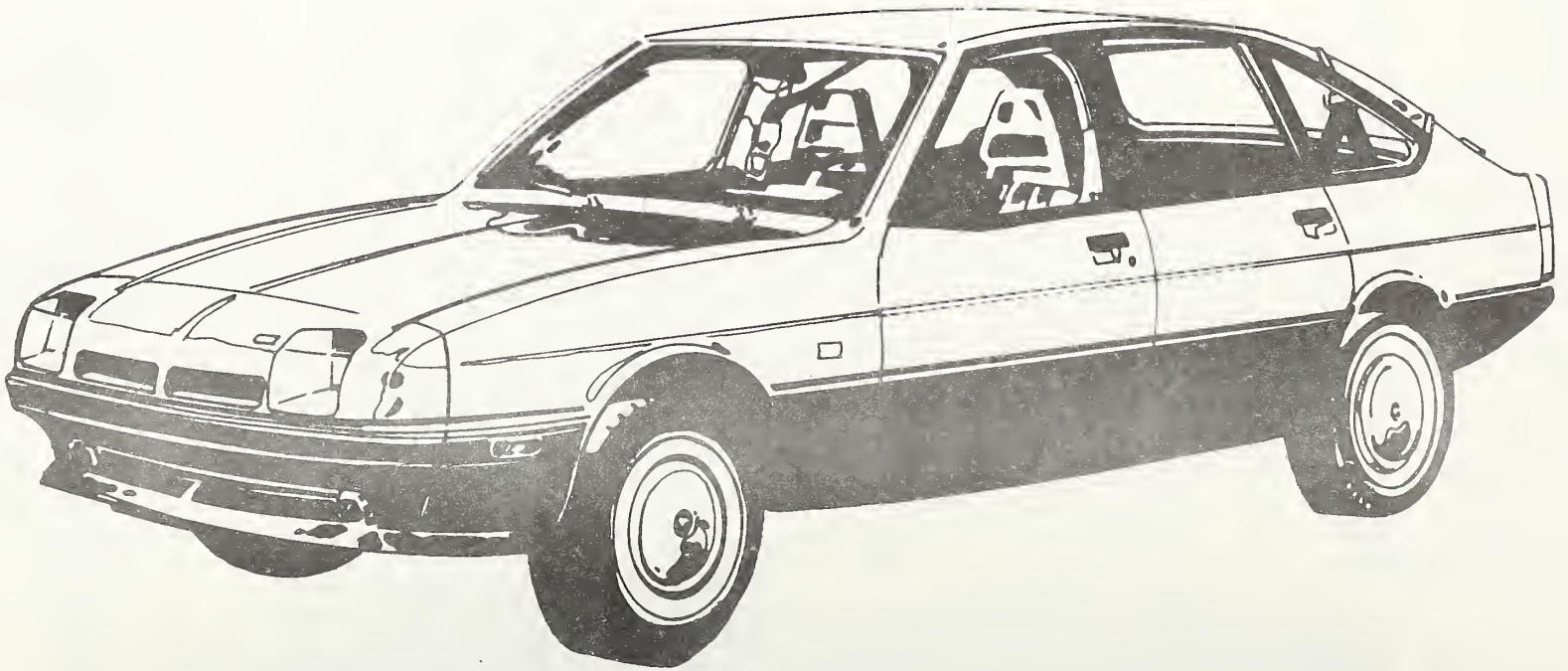

Figure 1.3-3 Calspan/Chrysler MSV

Major safety improvements built into the MSV have been tested. The results demonstrate automatic occupant protection in frontal crashes at closing speeds of 80* mph, up to 50 mph in side, and 45 mph in rear impacts. The vehicle's plastic foam front significantly reduces potential impact injury to pedestrians at speeds up to 25 mph. (10)

The vehicle is equipped with soft-face, front and rear bumpers, which remain undamaged in 7 mph frontal-barrier and 5 mph rear impacts. These bumpers greatly reduce damage to other cars in a variety of low speed collisions. Its ride, handling, and performance qualities have been evaluated and found to be equivalent generally to other recently designed front-wheel-drive cars of the same size. The excellent braking performance and superior conspicuity offered by high mounted rear brake lights should contribute to improvements in accident avoidance by this car. (10)

The Calspan MSV's unique features include good fuel economy, better resistance to damage, and important improvements in safety.

No studies of consumer acceptance of this car have been conducted. However, since the styling, performance and interior dimensions are generally similar to other contemporary cars, positive consumer reaction to appearance, utility and comfort features is expected.

The major selling point of the Calspan MSV, however, is its capability of protecting occupants in severe collisions from all directions. In addition, the car can deliver fuel economy of 27 to 32 mpg.

*Approximately equal to a crash with a barrier at 40 mph

1.4 CONSUMER DEMAND FOR SAFE AUTOMOBILES

Consumers as a whole, when asked if automobile safety is important, respond affirmatively. Numerous studies conducted by government, industry and public interest groups document strong, positive consumer statements on automotive safety.

Americans, according to a 1978 Harris poll, rank auto safety as the top priority for government in improving U.S. transportation. Interestingly, this survey was conducted for Amtrak to assess public opinion on intercity rail passenger service. Yet, auto safety was ranked at the top, above mass transit, highway congestion, and the need for new airports as the most important problem. (Eighty-three percent of those polled ranked it at the top of the list). (11)

Support is also reflected in a 1978 Peter Hart Research Associates survey conducted for NHTSA. Results show that the public is concerned about auto safety more than about fire, job accidents, airplane crashes, and several other disasters. About 90 percent of new car buyers rate safety and safety features as an important factor in buying a new car. Most people believe that cars should have as many safety features as possible built into them. (12)

Various studies completed by General Motors between 1971 and 1978 verify the high demand for safety features, especially air bags. A 1979 GM study stated that "Consumers are overwhelmingly in favor of some kind of occupant restraint system." A marketing study done by GM in 1978 on automatic restraints showed a strong willingness on the part of new car buyers to pay extra for very comfortable and convenient automatic belts or for air bags. Another GM study in 1979 showed that up to 70 percent of those surveyed preferred air bag systems over automatic belts, even though the survey questions included a price for air bags at over $350. (13)

In the past the industry has been slow to respond to the safety needs of the driving public. Essentially, consumers have had only rare opportunities to purchase a safer vehicle. American companies do not advertise the safety characteristics of their cars.

As an example, industry response to safety is reflected in GM's decision to provide air bags in only six-passengers cars, after their own studies showed that consumers of other size vehicles also want more safety features. Generally, auto makers are deciding not to provide consumers with air bags despite the growing popularity of automatic safety features. The present situation with air bags is analogous to the period when automatic transmissions and air conditioners were first introduced to the American market. The industry regarded these new features as an investment and an opportunity to innovate

and to provide better, more comfortable cars to the public. Yet, early sales figures indicated a slow public acceptance. Today automatic transmissions and air-conditioners are in strong demand and are part of the standard American automobile. Safety features must be advertised and marketed with the same persistence as other new features offered by the manufacturer.

While various studies show support for safety in cars, consumers have no way of knowing which vehicles offer a higher degree of safety. They may, therefore, continue their buying habits established over a period of years.

Adverse consumer reaction to vehicles that have been publicized as having safety problems is a matter of record. If consumers believe a vehicle is unsafe, the sales and the price of that vehicle decline. This has been demonstrated recently in the decline in sales of Ford Pintos after publicity concerning problems with their fuel tank systems in rear-end collisions. Also, Chrysler's Omni and Horizon lines experienced a sales slump as a result of a report by Consumers Union that the cars displayed dangerous handling characteristics. When sales of these vehicles dropped, sales of other comparative sized vehicles increased.

These examples of consumer reaction are consistent with the results of qualitative research on consumer attitudes conducted by NHTSA. This research involved consumer discussion groups in 15 locations around the country in 1978 and 1979. Two perceptions regarding vehicle safety were found to be widely held by consumers. First, safety is related to car size, large cars being considered safer than small cars. Second, no difference in safety is perceived among vehicles in a given weight class. (14) However, consumers who purchased smaller cars for improved fuel economy generally recognized that they were sacrificing some crash protection in moving from a larger to a smaller car.

Market data indicate that a significant shift in demand toward small vehicles is occurring. In January 1979, small (subcompact and compact) cars and small trucks accounted for only 40 percent of the sales. One year later, from January 1980 to June 1980, small vehicle sales constituted 60 percent of the market.

As this market shift continues in response to increasing fuel prices, the competition for the small car share of the market can be expected to become more intense. Vehicles which offer unique features such as advanced safety along with high fuel economy would be competing in a currently vacant market segment.

The NHTSA is currently addressing the problem of providing the consumer information on the relative safety of new automobiles. The fuel economy ratings prepared by EPA have been most useful in distinguishing differences in fuel economy among automobiles and light trucks. These fuel economy ratings are advertised widely by the manufacturers and are a major consideration in purchasing a car. It is expected that a similar rating system for safety would be useful to consumers and could influence decisions of consumers on what car to buy.

As a first step toward a Federal New Car Crashworthiness Rating System, NHTSA recently released the results of crash tests of selected 1979 and 1980 models. The tests involved crashing cars into a fixed barrier in frontal tests and in moving barrier rear tests at speeds of 35 mph - five miles per hour above the speed required by existing standards. Only 4 cars out of 24 tested passed these higher level tests. All four cars which passed were produced domestically. (1) The RSV is designed to pass these tests at 40 to 50 mph. (6) Consequently, a rating system of this type could benefit consumers by advising them of relative safety differences among new cars and could assist the manufacturer in marketing safe cars. NHTSA is currently developing a safety rating system for new cars.

NHTSA is continuing to assess the parameters of consumer preference and perceptions of improved automotive safety. However, further work by the manufacturer would be required to determine the characteristics and size of the market for the RSV, and how to position the RSV in the market.

In the absence of market survey data on the specific RSV cars, an estimate of market potential must be made on the basis of assumptions. As a starting point, we can assume that those consumers who routinely wear their restraint systems would be potential buyers for the RSV. Recent survey data indicate that approximately 18 percent of small car occupants and 9 percent of large car occupants wear restraints. (15)

Marketing data indicate that in 1979 approximately 6 million compact and smaller cars were sold. Of these, 2.5 million were sold to consumers who previously owned mid-size or full-size cars. (16)

Assuming that 9 percent of the 2.5 million consumers were seat belt wearers and, therefore, interested in higher levels of safety, there would be a market size of 225,000 in 1979. This market is increasing rapidly as owners of large cars shift to smaller cars.

A second estimate of the potential market for safe automobiles could be based upon the 18 percent of the small car occupants who wear belts. Assuming that 18 percent of the 6 million small car buyers are interested in safety, it gives a market size of 1.08 million in 1979. How many of these safety conscious consumers, and how many consumers from other groups, would select the RSV would depend on price and other attributes of the vehicle. It is apparent that a potential market exists which must be considered seriously by any manufacturer, particularly those who are losing control of their traditional market due to foreign competition.

Added to this market potential are the annual purchases of passenger automobiles by the General Services Administration (GSA). The GSA maintains a fleet of approximately 95,000 passenger automobiles and purchases approximately 15,000 new automobiles each year for use in its civilian and military fleets. It is possible that a large number of the vehicles purchased by the GSA could include smaller, safer RSV-type cars even though initially, because of low volume production, they may carry a higher price tag than the less safe vehicles offered by competitors. Additionally, in 1978, the NHTSA queried fleet purchasers about their interest in purchasing air bag restraint equipped cars. A positive interest in purchasing 60,000 cars was identified.

While systematic and scientific studies to test public reception to the RSV have not yet been completed, information from consumer discussion groups and surveys conducted by NHTSA points to a high level of public enthusiasm for the concept of a vehicle designed for safety.

During April 1980, the NHTSA conducted a series of qualitative consumer discussion groups designed to gain insight into the attitudes of the car buying public with respect to their acceptance of the RSV and its safety features. (17) The discussion groups were held in six cities throughout the country and the participants were stratified by age, sex, income, and type of automobile currently owned.

The format of the discussion groups was to have the participants discuss their current automobile and their desires for features, attributes and capabilities in their next vehicle. A short film on small car/large car crash tests was then shown, followed by a film of the RSV in various crash test situations. Within this context, approximately a quarter of the discussion group participants expressed a sincere interest in learning more about the RSV and a number of them indicated a desire to purchase an RSV. The majority of the participants expressing interest to purchase were married, between the ages of 25 and 45, had children living at home, earned more than $15,000 per year, and had more than one vehicle in the household.

This demographic stratum purchases approximately 10 percent, or over 1 million of the new cars sold each year. Obviously, not all of these consumers would be inclined to purchase an RSV, but at the same time, purchasers of an RSV would not be limited to this demographic group. This qualitative study yielded results which indicate that households with children, above average income, and owning multiple vehicles would be the most probable purchasers of an RSV.*

The following quotations from the discussion groups are provided to illustrate the various motivational comments consumers made towards purchasing an RSV.

"If it's as safe as it appears, I'd buy it."

"If they show a car like that on TV, I guarantee they won't be able to keep up with the demand - especially when they see how safe it is - There are a lot of parents who would buy this for their children."

"I'd buy this car for my son so he could have a safe, sporty car."

"I would trust my daughter to drive this car."

"This is my dream car. If I can get it with the options I want, I would buy it tomorrow."

"When you have children, you really look at safety."

"This is a good car for my wife."

"My dream car - sporty, safe and fuel efficient."

"Everybody and their brother will want this kind of safety. When can I order it?"

"My teenager would love to get his hands on this car, but he'd have to fight me for it."

"What kind of price can you put on your life?"

---

*Although those results are not statistically significant, they are based upon commonly used market research procedures.

NHTSA has also displayed the Minicars RSV in numerous cities and communities throughout the United States, and the public has responded enthusiastically. Post cards returned voluntarily by those who have seen the RSV exhibit posed three main questions: (1) Why hasn't Detroit developed such a car? (2) When will it appear on the market? (Where can I buy one?) and (3) How much does it cost? (18)

Response to a RSV public service announcement on television has come in the form of phone calls to NHTSA's toll-free Auto Safety Hotline. In a six-month period, NHTSA received more than 7,500 calls, and nearly all expressed positive interest in the RSV. (19)

The primary point that emerges as conclusive from this discussion is that there is a strong interest in safer automobiles in the U.S. Consumers have traditionally equated automobile safety with size. The market shift to smaller cars may greatly accelerate consumer demand for small safe cars. Rough estimates indicate that a market in the order of 250,000 to 1,000,000 cars per year may exist for small safe vehicles. Market research is required to quantify this demand and to determine how to best market the RSV. A further previous impediment to marketing safety has been the inability of the consumer to distinguish exceptional levels of safety. The automotive safety ratings being developed by NHTSA will provide consumers the opportunity to select their vehicle on the basis of its crashworthiness.

1.5 PRODUCTION COST AND LEAD TIME

1.5.1 INTRODUCTION

The cost and lead time for producing an RSV has been studied and found to be about the same as producing conventional cars at a similar stage of development. However, the development work already undertaken by the government will reduce lead time and development costs for producing the RSV when compared to building an all-new, conventional car.

In order to evaluate the difference in cost and lead time, it is necessary to examine the production development process for a conventional car. The discussion of this process will be followed by a description of two options:

1. Produce the Minicars RSV.

2. Produce a car similar to the Calspan vehicle.

1.5.2 PRODUCTION OF A NEW AUTOMOBILE

An automobile is a complex system consisting of several thousand components. The components are manufactured with facilities and equipment used in the mass production of one part or a family of parts in order to take advantage of lower costs. A change to any component or group of components of the vehicle requires changes to the facilities and equipment for the manufacture of that component.

Generally, the activities required by a motor vehicle manufacturer to bring about product change can be categorized as follows:

Corporate Planning (product conceptualization, market research, cost estimation, finance, etc.)

Research and Development, Styling

Advanced Engineering

Product Production and Manufacturing Engineering

Manufacture and Installation of Tooling, Facilities and Equipment

Preproduction and Launch

Each of these activities has its associated lead time and costs. In evaluating possible production strategies for product change, it is useful to use the lead time and cost of these activities as a basis for comparison.

The overall length of a production program for a model year vehicle depends on the magnitude and complexity of the changes from the previous model. A face lift may involve only changes to the front and rear, exterior, trim and to the interior, and this does not involve major change to assembly or stampting plants. A reskin involves changes to the exterior body contours but the basic body structure and drivetrain remain the same. A reskin, however, involves extensive design work and major changes to the assembly and stamping plants. An all-new car requires extensive engineering, test, design and complete changeover of tooling in the assembly and stamping plants. An all-new drivetrain involves a long program for design, development, and test of components and the changeover of engine, transmission, and other component plants.

Lead times for these changes vary. For example, to develop a new engine from prototype to production hardware could take as long as 10 years - 6-7 years for development and testing of engine components and 3-4 years for production design,

sourcing, and manufacture and installation of the production tooling and equipment. All-new car programs which do not involve the development of all-new powertrain components typically take 3 to 3 1/2 years. A company can, of course, shorten this time if it chooses, although shorter leadtime could increase costs.

There are two major phases of the all-new-car production cycle - the planning and design phase and the hardware phase. These phases are shown in Figure 1.5-1. The hardware phase commences when the vehicle is approved for production, about two years before the first production car comes off the assembly line (JOB 1). At this time, the selection of tooling for vehicle assembly is begun. Transfer machinery for manufacture of components, if required, may be ordered somewhat earlier. This period of two years before JOB 1 cannot be compressed substantially because it involves lead time for the manufacture of production tooling and equipment. Leadtimes are relatively constant for various types of machinery and equipment used by the automotive industry.

The length of the planning and design phase, on the other hand, can be as short as a year or as long as three, depending on the magnitude of the task, the resources and priority committed to the job, the schedule of other product changes, and the risk that the manufacturer is willing to take.

The decision on what product to make and when to introduce that product in the market involves risk for the manufacturer. Decisions based on market research made early in the program -- which determine product concept, styling, size and weight -- result in the investment of large sums of money several years later. Changes in the market after the production decision is made may result in producing the wrong product. As an example, for the 1980 model year, some domestic manufacturers retooled to manufacture large cars which did not sell in the quantities expected. Indecision and delay, on the other hand, may mean a late response to competition and result in loss in sales. In the current market, domestic manufacturers have not produced sufficient numbers of marketable subcompact cars to meet the competition of the Japanese manufacturers. Incomplete engineering and testing to save time or resources can result in failure of components, expensive warranty costs and recalls. The manufacturer must carefully weigh the risks in establishing the goals and schedules for producing a new vehicle.

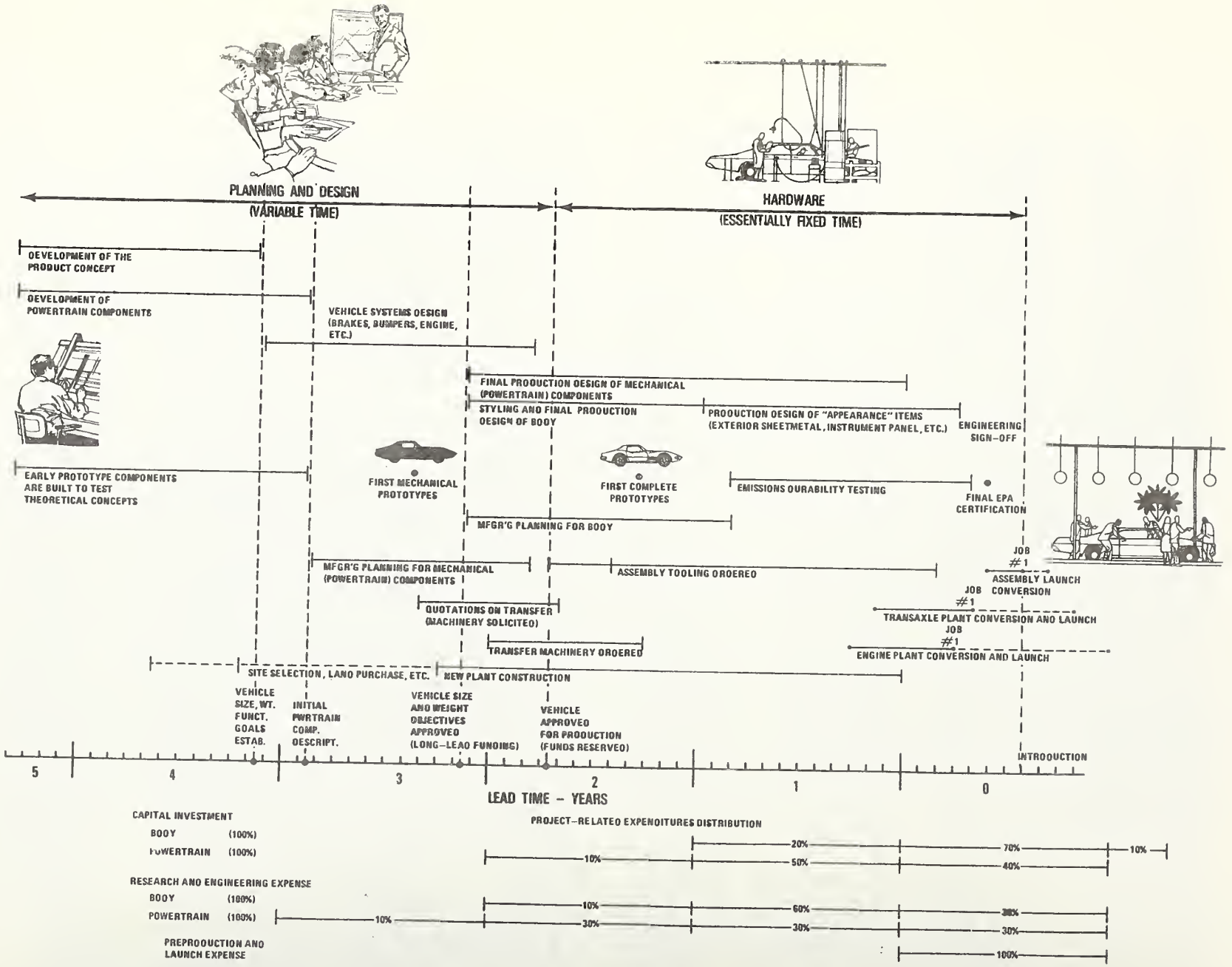
PLANNING AND DESIGN
(VARIABLE TIME)
HARDWARE
(ESSENTIALLY FIXED TIME)
DEVELOPMENT OF THE PRODUCT CONCEPT
DEVELOPMENT OF POWERTRAIN COMPONENTS
VEHICLE SYSTEMS DESIGN (BRAKES, BUMPERS, ENGINE, ETC.)
FINAL PRODUCTION DESIGN OF MECHANICAL (POWERTRAIN) COMPONENTS
STYLING AND FINAL PRODUCTION DESIGN OF BODY
PRODUCTION DESIGN OF "APPEARANCE" ITEMS (EXTERIOR SHEETMETAL, INSTRUMENT PANEL, ETC.)
ENGINEERING SIGN-OFF
EARLY PROTOTYPE COMPONENTS ARE BUILT TO TEST THEORETICAL CONCEPTS
FIRST MECHANICAL PROTOTYPES
FIRST COMPLETE PROTOTYPES
EMISSIONS DURABILITY TESTING
FINAL EPA CERTIFICATION
MFGR'G PLANNING FOR BODY
MFGR'G PLANNING FOR MECHANICAL (POWERTRAIN) COMPONENTS
ASSEMBLY TOOLING ORDERED
JOB #1 ASSEMBLY LAUNCH CONVERSION
QUOTATIONS ON TRANSFER MACHINERY SOLICITED
JOB #1 TRANSAXLE PLANT CONVERSION AND LAUNCH
TRANSFER MACHINERY ORDERED
JOB #1 ENGINE PLANT CONVERSION AND LAUNCH
SITE SELECTION, LAND PURCHASE, ETC.
NEW PLANT CONSTRUCTION
VEHICLE SIZE, WT. FUNCT. GOALS ESTAB.
INITIAL PWRTRAIN COMP. DESCRIPT.
VEHICLE SIZE AND WEIGHT OBJECTIVES APPROVED (LONG-LEAD FUNDING)
VEHICLE APPROVED FOR PRODUCTION (FUNDS RESERVED)
INTRODUCTION
5
4
3
2
1
0
LEAD TIME - YEARS
CAPITAL INVESTMENT
BODY (100%)
POWERTRAIN (100%)
PROJECT-RELATED EXPENDITURES DISTRIBUTION
10%
20%
50%
70%
40%
10%
RESEARCH AND ENGINEERING EXPENSE
BODY (100%)
POWERTRAIN (100%)
10%
10%
30%
60%
30%
30%
30%
PREPRODUCTION AND LAUNCH EXPENSE
100%

Figure 1.5-1

During the planning and design phase, the manufacturer carries out extensive market research to determine the concept of the car and how to position it in the market. Clay models are constructed to evaluate styling features and prototype components are built to test engineering assumptions and calculations At the end of this phase, product concept, vehicle size, weight and functional goals have been established. Initial powertrain components have been identified. The design of vehicle systems such as the engine, transmission, brakes, bumpers, electrical, etc., are completed. Mechanical prototype vehicles are constructed for testing, and planning and procurement for manufacturing of powertrain components is carried out. About 2 1/2 years before production, final production design of powertrain components, styling and final production design of the body, and manufacturing planning for building the body are begun.

At the beginning of the hardware phase, the vehicle is approved for production. Assembly tooling and machinery for manufacture of powertrain components are ordered as necessary. Funds are set aside for the purchase of production equipment which will be delivered over the succeeding two years. During this phase, the manufacturer is committing large resources to the program. About 80-90 percent of the total cost of the program will be expended during the succeeding two years.

In the last 18 months of the program, the final production design of the exterior sheet metal and trim, the interior trim, and instrument panel are completed. Emissions testing is begun and drivetrain component plants are converted to production. The first production drivetrain components are completed 4-6 months before the JOB 1.

The estimated expenses and capital costs for production of a new car are listed in Table 1.5-1.

In many cases, manufacturers are able to use existing engines and drivetrains and other parts on new models, and thereby substantially reduce the costs as well as the lead time. Table 1.5-1 shows two options - one assuming an existing drivetrain is available or can be procured from a supplier, the other assuming a new drivetrain must be developed and produced. When a new drivetrain is required, substantially high costs are involved, as shown in Table 1.5-1.

The costs for producing a new vehicle fall into two categories-expenses and capital costs. The expenses include R&D, Styling, Advanced Engineering, Product/Manufacturing Engineering and Preproduction Launch Costs. These expenses generally run between $110 to $140 million on a typical car using an existing drivetrain.

Table 1.5-1 also shows the capital costs which generally range from $280 to $340 million for a new vehicle which uses an existing drivetrain.

The total costs of producing an all-new car are about $390 to $480 million using an existing drivetrain and are $1.09 to $1.3 billion using a new drivetrain.

1.5.3 OPTION 1 - PRODUCE THE MINICARS RSV

To date about $14 million has been spent on the design, development testing and construction of the Minicars RSV. At the present time, 18 prototype vehicles have been constructed and four additional vehicles are being constructed for testing in the near future. Drawings of the prototype vehicles exist, and engineering reports covering the development and test of these vehicles are available. Models of the vehicles themselves also are available to a potential manufacturer.

Preparation of production drawings of components and design of tooling have not been accomplished. Although the vehicle has been laboratory tested for vibration and durability, extensive environmental and durability testing is still required. This testing is normally conducted on the first mechanical prototypes which are generally available about 3 years from production (see Figure 1.5-1). RSV prototypes are currently available for this testing. In order to bring the Minicars RSV into mass production, the normal process of planning, engineering, and manufacturing of equipment and tooling must be carried out. This process would require the 2 year hardware phase plus a portion of the planning and design phase. The latter phase could probably be shortened to about 1 year, or less if adequate priority were assigned by management. Consequently, the RSV could be mass produced in 3 years or less.

The Minicars RSV has significant features which will affect its manufacturability when compared to conventional domestic automotive design. However, none of these features requires radical changes in manufacturing procedures, and, therefore, the cost and lead time for accomplishing the changes in tooling, facilities, and equipment should be about the same as for any model change of the same complexity. The major areas of difference from conventional car design are as follows:

Plastic and foam front and rear structure for reduced damageability and pedestrian protection.

Flexible plastic fenders and exterior body surfaces.

TABLE 1.5-1

TYPICAL EXPENSES AND CAPITAL COSTS FOR
ALL-NEW-CAR PROGRAM FOR ONE CAR LINE

COST CATEGORY	COSTS IN MILLIONS OF DOLLARS	
EXPENSES	USING EXISTING DRIVETRAIN	NEW DRIVETRAIN
R&D, Styling Advanced Engineering Product/Manufacturing Engineering Pre-Production and Launch	110-140*	310-370*
CAPITAL COSTS		
Assembly Plant	60-80	60-80
Stamping Plant	120-140	120-140
Engine Plant	----------	200-240
Transmission Plant	----------	300-350
Component Plants	100-120	100-120
TOTAL	390-480	1 090-1,300

NOTE: Costs in 1980 dollars
Capital Costs include only tooling and equipment
Source: Automotive Manufacturing Capital Data Base, Transportation Systems Center
*Total for all expenses

Frontal and side structures of lightweight sheet metal with stabilizing foam.

Automatic restraint systems.

Production tooling for the Minicars RSV must be designed and manufactured as in an all-new-car program. Although processes for manufacture of the foam-filled body panels have not been developed for the automotive industry, urethane foam parts have been manufactured in the refrigerator and portable cooler industries for many years and similar processes could be utilized for automobiles. Flexible bumpers are state-of-the-art components and can be supplied by component suppliers such as Davidson Rubber. Flexible fenders and other body parts can also be produced by suppliers of the automotive industry. Air-cushion restraint systems should be available in production by model year 1982 as a result of the implementation of FMVSS 208 (automatic restraints) in large passenger cars by several manufacturers. Suppliers of air cushion components include Hamill, Talley and Thiokol. Therefore, manufacture capabilitiy of the RSV is considered to be within the state-of-the-art.

The estimated expenses and capital costs for production of the Minicars RSV are as follows: The research and development and styling expenses which are normally incurred by a new-car development program have been reduced by an estimated $14 million as a result of the design and development work already completed by Minicars for the Department of Transportation. Therefore, total expenses should be in the $110 to $120 million range shown in Figure 1.5-1. Capital costs are estimated as follows: $70 million for rearranging fixtures, modifying vendor tooling for trim, mouldings and other parts, and installing the foaming system; $120 million for new dies and modifications to the stamping plant; and $100 million for tooling for the automatic restraint system, no-damage bumpers, and moulded plastic parts for front end fenders, and other components. The total expenses and capital costs for the Minicars RSV program are estimated at $400 million. As shown in Table 1.5-1, the total costs for a typical new-car program are normally in the range of $390 to 480 million dollars. The level of the cost for preparing to manufacture the RSV is typical of those for any new-car program. It is assumed that components for a rear-engine, rear-drivetrain configuration are available in the manufacturer's inventory or can be purchased from another manufacturer. If not, additional capital costs (as shown in Table 1.5-1) would be needed to design, develop, and manufacture tooling for these components.

The feasibility of mass producing an automobile like the Minicars RSV was studied by the Budd Company, under subcontract to Minicars, Inc. The objective of the work was to take the basic concept and structural design and develop it to produce 300,000 cars per year, with particular emphasis on the sheet metal body and foam filling that body. The study was based on a comparison of the producibility of the Minicars RSV utilizing the Ford Pinto as a baseline. (20)

This study indicates that the Minicars RSV is mass producible in quantities of 300,000 per year with process changes for manufacture of the foam-filled body structure. The cost for tooling for the RSV with advanced systems was estimated by the Budd Company to be about $134 million compared with the baseline Pinto of $120 million in 1980 dollars. This estimate compares reasonably well with the typical capital costs cited in Table 1.5-1 when the Budd estimate is adjusted for the assumption that no changes are required in assembly plants other than for foam filling. The tooling cost is not much different than that of a Pinto. This cost difference is more than offset by the cost of the development work already done by the Department of Transportation on the RSV. The Budd Company also estimated a manufacturing cost of the Minicars RSV at $5,250 in 1980 dollars. The price to consumers was estimated to be about $6,800.

The limited production of the Minicars safety vehicle is actively under consideration at this time. A new corporation, Response Motors, Inc., has been established to produce limited quantities of the Minicars RSV in Puerto Rico. Its principal backing to date is from Minicars, Inc., and the Puerto Rican government. Feasibility studies are being completed, and a tentative financing package has been developed which includes loan guarantees similar to those developed for DeLorean Corporation when it was considering producing a car in Puerto Rico.

1.5.4 OPTION 2 - PRODUCE A CAR SIMILAR TO THE CALSPAN SAFETY VEHICLE

The Calspan prototype was developed by modifying an existing car (the Simca 1308) to upgrade its performance in crashworthiness and damageability by improving the structure and the occupant restraint systems.

The structural changes needed for controlled crushability in the area ahead of the cowl section and the passenger compartment can be accomplished through simple modifications to the existing structure. The engine supports and compartment of the Calspan MSV were redesigned to prevent the engine from infringing on the passenger compartment in frontal collisions.

Other areas requiring modification to ensure the integrity of the passenger compartment include roof structural elements to provide rollover protection and strengthened doors. These structural changes can be accomplished using existing production facilities while maintaining normal assembly line processes.

The occupant restraint system consists of an air cushion on the driver side and an automatic, air-belt system for the front-seat passenger. For a production vehicle, one of these systems probably would be selected and produced by a component supplier. The foam-filled, front and rear bumpers are state-of-the-art components and could be produced by several component suppliers.

In summary, with proper component design and selection of materials, the processes for manufacture and assembly of the Calspan MSV are not much different from those currently being used by the domestic auto industry.

The feasibility of producing the MSV in annual volumes of 300,000 in a single assembly plant in the United States, using conventional sources for components, has been studied by Chrysler. (21) Engineering, program, tooling, facilities, pre-production, and launch costs were estimated by Chrysler to be about $76 million in 1980 dollars over and above the cost of the baseline tooling for the Simca. The lead time needed to make changes for the Simca tooling would be about 2 years. The consumer price differential for this vehicle over the baseline Simca was estimated by Chrylser at about $1,800 for the basic occupant protection and pedestrian protection features. The base Simca was not imported into the U.S. Therefore, it did not meet U.S. standards for safety or emissions. The cost differential between the Calspan safety vehicle and a base vehicle which meets the standards of the mid-80's should be less than the differential estimated by Chrysler.

It should be noted that the Simca 1308 was produced in Europe beginning in 1975. The Simca 1308 was a forerunner of the successful U.S. designs to come later such as the Chrysler Omni/Horizon and the GM X-cars. These more recently designed production vehicles have a higher level of safety than the base Simca 1308 but offer less effective protection than the Calspan safety vehicle.

Rather than using the Simca 1308 as a base vehicle, it would probably would be more attractive to a U.S. manufacturer to apply the safety features of the Calspan vehicle to one of its production cars.

Producing an MSV type car by using another existing production car as a base would be substanially cheaper and require less lead time than an all-new-car program (shown in Table 1.5-1) and would be similar in scope to production of the

Calspan MSV from the Simca tooling. The concept, styling, and component design and development already accomplished on the base car would not have to be repeated. The changes would involve the design, development and testing of a modified body structure and new subsystems such as the automatic restraint system, no-damage front end, and pedestrian protection bumper.

Since the body structure needs to be substantially changed in the front end, floor, doors, and roof, this change could be combined with a reskin of the body exterior to give the car an all-new look at an intermediate point in the model change cycle. It is likely that the dies for the exterior of the body would have to be changed anyway due to the significant modifications in the body structure. The instrument panel and steering wheel would be redesigned to incorporate the automatic restraint system. No-damage bumpers and soft-front-end components would be designed by the manufacturer and furnished by component suppliers. Interior trim would be redesigned to incorporate safety padding. Exterior trim mouldings instrument clusters, and other parts probably would require little change. Tooling costs for these components are included in the costs of assembly plant conversion.

The costs of the program to upgrade an existing car to include features of the Calspan MSV are listed in Table 1.5-2. Costs for this approach are in the range of $250 to $330 million. Expenses of such a program are about the same magnitude as those incurred for any intermediate-model-year program involving a reskin and are less than the all-new-car program. Extensive changes are required in the assembly and stamping plants due to the new body design. Should it be possible to design a new body without manufacturing new dies for the large body stampings, the costs for the stamping plant could be substantially reduced - possibly by $100 million. Additional costs would be incurred for tooling for components manufactured by vendors, such as the automatic restraint systems and the damage resistant soft front bumpers.

The lead time for such a program would be 3 to 3 1/2 years, or less depending upon the length of the design and planning phase.

TABLE 1.5-2

TYPICAL EXPENSES AND CAPITAL COSTS FOR A PROGRAM TO PRODUCE ONE CAR LINE OF EXISTING CAR UPGRADED WITH SAFETY FEATURES

COST CATEGORY	COSTS IN MILLIONS OF DOLLARS	
EXPENSES	USING EXISTING DRIVETRAIN	NEW DRIVETRAIN
R&D, Styling Advanced Engineering Product/Manufacturing Engineering Pre-Production and Launch	50-70**	240-290**
CAPITAL COSTS		
Assembly Plant	60-80*	60-80*
Stamping Plant	120-140*	120-140*
Engine Plant	----------	200-240
Transmission Plant	----------	300-350
Component Plants	20-40	20-40
TOTAL	250-330	940-1,140

Costs in 1980 dollars
Capital Costs include only tooling and equipment
These costs can be reduced substantially if major stamping dies can be used for RSV body*
Total for all expenses**
Source: Automotive Manufacturing Capital Cost Data Base, Transportation Systems Center

1.6 SUMMARY AND CONCLUSIONS

1.6.1 SUMMARY

This chapter summarizes the capability of an automobile manufacturer to produce automobiles similar to the type developed for the National Highway Traffic Safety Administration under its Research Safety Vehicle (RSV) program.

It is clear that there is growing consumer interest in safer cars. With the shift to smaller cars for fuel efficiency, there appears to be a potential market for a small, safe car and a number of consumers seem willing to pay for improved safety.

The RSV's are experimental cars built to show the American public and the auto manufacturers how safe, attractive, and economical a small car can be using today's technology. The most advanced Research Safety Vehicle was constructed for NHTSA by Minicars, Inc., of Goleta, California. This RSV includes such innovative features as damage resistant fenders and bumpers. It offers lifesaving protection to occupants in severe crashes up to 50 mph through the use of air bags and a unique energy absorbing structure. The level of safety is significantly greater than any other fuel-efficient car available to the public today.

Although some of the manufacturing processes required by this RSV are different than those currently used by the automobile industry, NHTSA studies show that similar processes have been used in related industries for many years. And, the cost of producing an RSV-type vehicle would not be significantly greater than the cost of an all-new, conventional car. Consequently, a car like the RSV could be competitively priced and marketed.

An analysis of the future automotive market indicates that producing safe cars could prove to be a very attractive investment. As cars become lighter and smaller, the potential conflict between fuel-economy and safety goals becomes more apparent. If consumers have a basis for distinguishing the differences in crash safety characteristic of various makes and models of cars, there is the potential for public demand for cars designed from the safety point of view, just as the market demanded fuel economy in the late 1970's.

Accident data indicate that small cars are considerably less safe than large ones and that large-car/small-car collisions are growing in frequency as small cars become more numerous. Preliminary analysis of RSV test results indicates that small cars can be made much safer and if all cars on the

road had the safety and fuel economy characteristics of the RSV, annual highway deaths, which now total more than 50,000, would be reduced by 12,000 and fuel consumption could be cut in half.

Consumers generally are aware that small cars are not as safe in a crash as larger cars. However, because of a lack of information, they are unable to distinguish positive differences in safety among vehicles in a given weight class. NHTSA is attempting to fill this void by developing a Federal automotive, crashworthiness-rating system.

To redesign American automobiles with both fuel economy and safety in mind, the U.S. auto companies must change their engineering and marketing priorities. In the past the industry has been slow to respond to safety needs of the driving public. Essentially, consumers have had no opportunity to purchase a safer vehicle. American companies do not advertise their cars from the perspective of safety.

With foreign manufacturers continuing to gain a growing share of the domestic market, the U.S. companies must innovate rapidly in order to advance (or even maintain) their competitive position. Design and production of safe vehicles such as the RSV can provide domestic automakers with a competitive edge. The fact that all Japanese-made automobiles failed the recent NHTSA 35 mph crash test is a significant point that U.S. companies should note.

The U.S. industry should press the existing safety advantages of their cars and offer the public additional safety innovations such as air bags. The RSV-type vehicle could meet the public demand for safe, fuel-efficient automobiles, as well as provide American manufacturers with a viable advantage over foreign manufacturers.

The introduction of the RSV in public demonstrations over the last year has brought an overwhelming response. Post cards and telephone calls indicate that consumers are interested in seeing the RSV marketed and wonder why it isn't available now.

By producing the RSV, a manufacturer could exploit the unsatisfied need for a safe, fuel-efficient car. Such a venture could be highly profitable, because it would allow entry into a segment of the market where little competition exists.

1.6.2 CONCLUSIONS

1.6.2.1 Marketability

- Existing small cars are not as safe as large ones, and are so perceived by consumers.
- RSV-type cars could save thousands of lives and considerably reduce fuel consumption.
- Consumers believe that auto safety is a top priority.
- Most consumers recognize they are trading safety for fuel economy when they move to a smaller car.
- A significant market shift from large cars to smaller cars is likely to continue with many buyers looking for additional safety in these smaller, fuel-efficient cars.
- Demand for small, safe cars like the RSV exists, and could be on the order of 250,000 to 1,000,000 vehicles per year.
- Research is needed to determine the extent of the demand, and the profit potential for building such a car.

1.6.2.2 Producibility

- RSV-type cars can be mass produced.
- The small increase in tooling costs for the Minicars RSV is offset by the savings from government development work already completed.
- The cost and expenses of developing new tooling to produce a new safe, fuel-efficient car are about the same as those for launching a conventional new model-about $400 million.
- Production strategies include two options:

    1. Producing the Minicars RSV
    2. Producing a modified production vehicle similar to the Calspan vehicle

Option 1, producing the Minicars RSV, provides a vehicle substantially ahead of the competition, but it is also a little different from the traditional industry approach because it requires innovation. It is a slight departure from the norm. However, this risk may be considerably less than the risk of producing an average product in a competitive market. Studies estimate the price to the consumer of this RSV vehicle at about $6800.

Option 2, producing the Calspan vehicle, would cost about the same to build as the Minicars vehicle because new tooling would be required. The Calspan vehicle does not have the safety capabilities of the Minicars RSV, and, therefore, may have less sales appeal. Studies by Chrysler estimate that the price of this car would be approximately $1,800 higher than the 1975 French Simca on which it was based. The base Simca did not meet U.S. safety or damageability standards.

A more attractive alternative within this option is to upgrade the safety of an existing vehicle being produced by the manufacturer. The cost of producing this modified vehicle is much less than the cost of producing an all-new vehicle. There is a degree of risk involved in this approach since the vehicle may not be significantly ahead of the competition.

- The options presented here could allow a manufacturer to produce safe, fuel-efficient cars within 3 to 3 1/2 years, provided, of course, that the company gives this project appropriate priority.

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    Figures are taken from the daily computer survey at the NHTSA Hotline office where RSV calls are received.

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21. Research Safety Vechicle Program (Phase II) Producibility Studies. Volume II - DOT Report No. DOT-HS-802-252, February 1977.

APPENDIX A RSV PROGRAM PARTICIPANTS

C - CALSPAN, M - MINICARS, C, M - BOTH

MICHIGAN

	FIRM	SERVICE PRODUCT
C -	Allied Chemical Mount Clements, Michigan 48043	Restraint Systems Components
C -	Chrysler Corporation Detroit, Michigan 48203	Design, Styling, Body Stampings, Chassis Components, Engines, Production Studies
C, M -	Creative Industries of Detroit Detroit, Michigan 48234	Fabrication, Assembly, Design Support
C -	Essex Chemical Troy, Michigan	Windshield Adhesive
C -	Great Lakes Steel Detroit, Michigan	HSLA Steels
C -	ITI Auto Electric Division Oakpark, Michigan 48237	Wiring Harness
C -	Modern Engineering Berkley, Michigan 48072	Test Vehicle Fabrication, Tooling
C -	Motor Wheel Corporation Lansing, Michigan 48914	Tire Pressure Sensors
M -	One Way Industries, Inc. 845 E. Mandoline Madison Heights, Michigan 48071 (313) 585-8550	Tooling for RIM Parts Produced by Bailey Division, USM Corp.
C -	Saginaw Steering Gear Division Saginaw, Michigan	Driver Air Bag Slip Ring Assemblies

CONNECTICUT

M -	D & D Engineering Brookfield, Connecticut	LRSV Powertrain Development

OHIO

FIRM	SERVICE/PRODUCT
C - Amanda Bent Bolt Company	Hood latch Components
M - The Firestone Tire & Rubber Co. 1200 Firestone Parkway Akron, Ohio 44317 (216) 379-6108	Advanced Concept Tires (Flat-Proof)
C - Capital Plastics of Ohio Bowling Green, Ohio 43402	Plastic Materials
C - Custom Trim Products Cleveland, Ohio 44215	Side Rub Strips
C, M - Battelle Columbus Laboratories 505 King Avenue Columbus, Ohio 43201 (614) 424-6424	Pedestrian Injury Impact Testing

IOWA

C - Sheller-Globe Corporation Keokuck, Iowa	Interior Trim Components

ILLINOIS

C - Atwood Vacuum Machine Company Rockford, Illinois 61101	Seat Tracks

INDIANA

C, M - Bendix South Bend, Indiana	Adaptive Braking System (Anti-Lock)
C - Essex Group, Inc. Ft. Wayne, Indiana	Wiring Harness

MINNESOTA

FIRM	SERVICE/PRODUCT
C - Conwed Corporation St. Paul, Minnesota	Headliners
C - Lake Center Industries Winona, Minnesota 55987	Secondary Hood Latches
C - 3M Company St. Paul, Minnesota 55101	Adhesives, Reflective Stripping

WISCONSIN

M - University of Wisconsin-Madison Department of Electrical and Computer Engineering 1425 Johnson Drive Madison, Wisconsin 53706 (608) 262-3480	Studies of Automatic Shifting Mechanisms

CALIFORNIA

C, M - Hexcel Corporation Dublin, California 94566	Aluminum Honeycomb (EA Padding) and Exterior Scuff Pads
C - Rockwell International Los Angeles, California	Passive Belt Drive
M - Armour World Wide Glass Co. 9401 Ann Street Santa Fe Springs, California 90670 (213) 723-0851	Glass, Door, Rear Quarter and Hatchback
M - Forming Specialties Inc. 16921 Southwestern Avenue Building 112 Gardena, California 90247 (213) 323-2729	Tooling and Parts for Body
M - Kinetic Research, Inc. Goleta, California	Benefit/Cost Analysis Model and Studies

CALIFORNIA (Cont'd)

FIRM	SERVICE/PRODUCT
M - Hughes Bros. Aircrafters, Inc. 11010 GArfield Place South Gate, California 90280 (213) 773-4541	Tooling and Stamped Parts for Upper Body Structure
M - Developmental Sciences, Inc. 15747 East Valley Road City of Industry, California (213) 330-6865	Tooling and Parts for Interior Trim Pieces, Dash Panel, Etc.
TEXAS	
C -Lone Star Manufacturing Houston, Texas 77001	Air Conditioning Condensers
UTAH	
C, M - Thiokol Corporation Brigham City, Utah 84302	Restraint Inflators
NEW HAMPSHIRE	
C - Davidson Rubber Company Dover, New Hampshire 03820	Bumpers, Spoiler, Aerodynamic Wheel Covers
M - USM Corporation Bailey Division Route No. 1 Seabrook, New Hampshire 03874 (Manufacturing Plant) (603) 474-3011	Energy Absorbing Bumpers Molded Plastic Hood, Fascia, and Fenders
NEW JERSEY	
M - RCA Laboratories Microwave Technology Center David Sarnoff Research Center Princeton, New Jersey 08540	Develop Radar System and Micro-Computer; Develop Driver Displays

NEW JERSEY (Cont'd)

FIRM	SERVICE/PRODUCT
M - Aero Tec Laboratories, Inc. Hewson Avenue Waldwick, New Jersey (202) 444-6080	Fuel Cells
M - Volvo of America Corporation Rockleigh, New Jersey 07647	Turbo-Charged Engine with Lambda-Sond Emission Controls

NEW YORK

C - Roblin Industries Buffalo, New York 14202	Materials Recycling Studies
C - Standard Mirro Co., Inc. Buffalo, New York	Outside Mirrors (Convex)
C - General Electric Co. Schenectady, New York	Lexan Headlights Covers Rear Quarter Windows
M - Dubner Computer System, Inc. 1740 Broadway New York, New York 10019 (212) 582-6251	Analysis and Computer Design for Tranmission, Computer
C - J. R. Products, Inc. Buffalo, New York	Driver Air Bag Covers

PENNSYLVANIA

C - PPG Industries Pittsburgh, Pennsylvania 15222	Front Door Glass
M - The Budd Company Technical Center 375 Commerce Drive Fort Washington, Pennsylvania 19034 (215) 643-2950	Structures Design, Testing and Production Analyses

SWEDEN

FIRM	SERVICE/PRODUCT
C - Volvo Corporation S-405 06 Goteborg, Sweden	Air Bag Steering Wheels, Head Restraints

FRANCE

C - CIBIE Corporation Paris, France	Plastic Single Beam Headlights, Hi-Level Rear Lamps, Headlight Levelers
C - Saint Gobain 92209 Neuilly, France	Windshields (Secoroflex)

JAPAN

C - Mauri Industrial Company Kanagawa, Japan	Soft Trim Emblems, Highlight Bezels
C - Takata Kojyo Company Tokyo, Japan	Passive Belt EA Webbing

ENGLAND

C - Motor Insurance Repair Research Centre (Thatcham) Berkshire RGIS 4MP England	Collision Repairability Studies

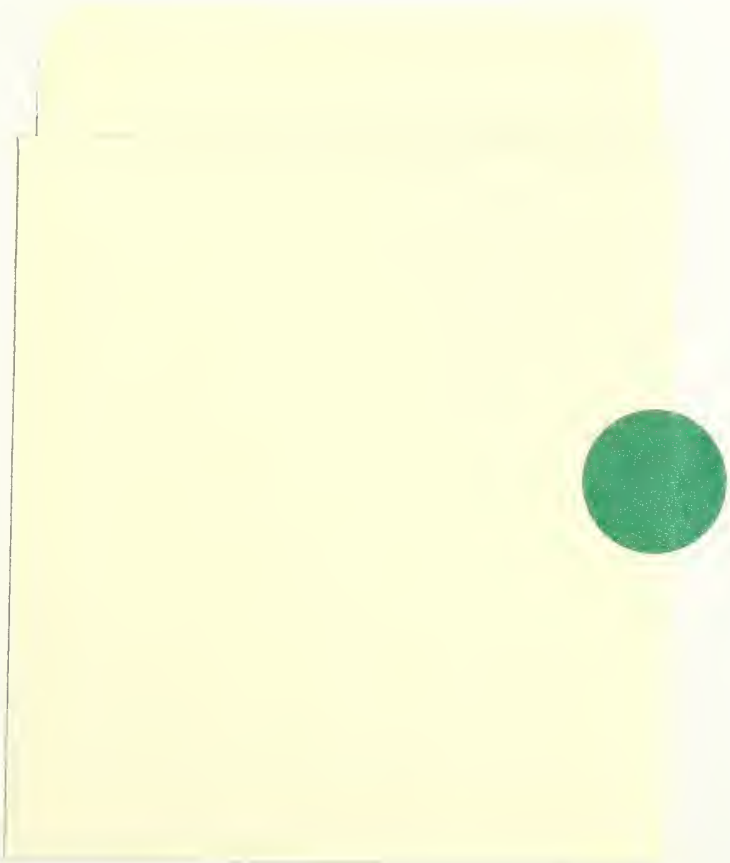
CANADA

C - Irvin Industries Ft. Erie, Ontario Canada L2A SM9	Air Belts and Air Bags

ITALY

M - Fiat Motors of North America Turin, Italy	Steering, Suspension and Brake Assemblies

C - 33/55
C, M - 5/55
M - 17/55



DOT HS 805 644
December 1980